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$$CEG \text{ we get } \tan \theta = \frac{v^3}{gr}, \cos \theta = \frac{gr}{\sqrt{(g^2 r^2 + v^4)}}; \therefore \sqrt{\frac{(r^2 + h^2)}{h^2}} = \sec \theta \\ = \frac{\sqrt{(g^2 r^2 + v^4)}}{gr}. \therefore P = \frac{m \sqrt{(g^2 r^2 + v^4)}}{gr}, \text{ but } m = 1500 \text{ pounds, } r = 500 \text{ feet,}$$

$v = 33$ feet per second, $g = 32$ feet. Substituting we get, $P = 1503.465$ pounds.

NOTE.—Professor Zerr constructed a diagram to accompany his solution but as the solution is sufficiently lucid without, we did not have a diagram made.

II. Solution by WILLIAM HOOVER, A. M., Ph. D., Athens, Ohio.

Let 500 feet $= r =$ the radius of the curve described by the center of gravity of the carriage considered horizontal, $a =$ the vertical distance of the center of gravity from the road, $2b =$ the width of the road, $v =$ the velocity, and $mg =$ the weight of the "outfit."

The resultant of the horizontal centrifugal force and the weight of the outfit must be perpendicular to the road, and if $\theta =$ the inclination of the road, we have, taking moments about a point in the outer circumference of the road,

$$(a \cos \theta - b \sin \theta) \frac{mv^2}{r} = mg(a \sin \theta + b \cos \theta) \dots (1),$$

$$\text{whence } \tan \theta = \frac{av^2 - bgr}{bv^2 + agr} \dots (2).$$

No value for b seems to be contemplated in the statement of the problem. Putting $b = 0$ in (2), $\tan \theta = \frac{v^2}{gr} \dots (3).$

$$\text{The whole pressure} = \frac{mv^2}{r} \sin \theta + mg \cos \theta \dots (4). \quad \text{The rest is only}$$

the numerical application of (4).

This problem was also solved by Professors MATZ, PHILBRICK and HUME.

DIOPHANTINE ANALYSIS.

Conducted by J. M. COLAW, Monterey, Va. All contributions to this department should be sent to him.

SOLUTIONS TO PROBLEMS.

13. Proposed by ARTEMAS MARTIN, LL. D., U. S. Coast and Geodetic Survey Office, Washington, D. C.

It is required to find four numbers the sum of whose fourth powers is a square number.

Solution by the PROPOSER.

Let $x, x-ay, v-by, x-cy$ denote the four numbers required; then must $x^4 + (x-ay)^4 + (x-by)^4 + (x-cy)^4 = \square \dots (1)$.

Expanding and arranging the terms according to the terms of x , we have $\pm x^4 - 4(a+b+c)x^3y + 6(a^2+b^2+c^2)x^2y^2 - 4(a^3+b^3+c^3)xy^3 + (a^4+b^4+c^4)y^4 = \square \dots (2)$; or, putting $a+b+c=m, a^2+b^2+c^2=n, a^3+b^3+c^3=p,$

$$a^4+b^4+c^4=q, 4x^4-4mx^3y+6nx^2y^2-4pxy^3+qy^4 = \square \dots (4).$$

Putting (4) $= [2x^2 - mxy + \frac{1}{4}(6n-m^2)y^2]^2$, expanding and reducing, we find $\frac{x}{y} = \frac{(6n-m^2)^2 - 16q}{8m(6n-m^2) - 64p},$

$$= \frac{[6(a^2+b^2+c^2) - (a+b+c)^2] - 16(a^4+b^4+c^4)}{8(a+b+c)[6(a^2+b^2+c^2) - (a+b+c)^2] - 64(a^3+b^3+c^3)}.$$

If $a=5, b=2, c=1$, then $\frac{x}{y} = \frac{199}{-72}$, and we may take $x=199, y=-72$.

These values give the numbers 199, 271, 343, and 553.

$$\therefore 199^4 + 271^4 + 343^4 + 553^4 = 344162^2.$$

14. Proposed by SYLVESTER ROBINS, North Branch Depot, New Jersey.

Find initial terms in each of three infinite series of prime, integral, rational, scalene triangles, where 9 shall be the base, and the other two sides of every term shall have a constant difference.

Solution by ARTEMAS MARTIN, LL D, U. S. Coast and Geodetic Survey Office, Washington, D. C.

Let $x+\frac{1}{2}d$ and $x-\frac{1}{2}d$ be "the other two sides;" then the area of the triangle is $\sqrt{[(x+\frac{1}{2}d)(\frac{1}{2}-\frac{1}{2}d)(\frac{1}{2}+\frac{1}{2}d)(x-\frac{1}{2}d)]}$, which must be rational, or $(20\frac{1}{4}-\frac{1}{4}d^2)(x^2-20\frac{1}{4}) = \square \dots (1)$.

Put $20\frac{1}{4}-\frac{1}{4}d^2 = e^2$, then (1) becomes $e(x^2-20\frac{1}{4}) = \square \dots (2)$.

Put $e(x^2-20\frac{1}{4}) = \frac{p^2}{q^2} (x+\frac{1}{2}d)^2$, then we get $x = \frac{4\frac{1}{2}(eq^2+p^2)}{eq^2-p^2}$;

$$\therefore x+\frac{1}{2}d = \frac{(4\frac{1}{2}+\frac{1}{2}d)eq^2 + (4\frac{1}{2}-\frac{1}{2}d)p^2}{eq^2-p^2}, x-\frac{1}{2}d = \frac{(4\frac{1}{2}-\frac{1}{2}d)eq^2 + (4\frac{1}{2}+\frac{1}{2}d)p^2}{eq^2-p^2}.$$

Now eq^2-p^2 may have any value, positive or negative, that will exactly divide the numerators of the expressions for $x+\frac{1}{2}d$ and $x-\frac{1}{2}d$.

It is plain that d must be an odd number, and it must be less than 9, and therefore can not be greater than 7.

I.—Take $d=1$, then $e=5$, and $5q^2 \nearrow p=1$ will satisfy this case. The least values of p and q are $p=2, q=1$, which give 40 and 41 for "the other two sides." Therefore the sides of the first triangle of the series having 9 for bases and a constant difference of unity between the other two sides are 9, 40, 41.

II.—When $d=3$, we have the numerator of $x+\frac{1}{2}d=6eq^2+3p^2=3(2eq^2+p^2)$, and the numerator of $x-\frac{1}{2}d=3eq^2+6p^2=3(eq^2+2p^2)$, both of which are always divisible by 3 whatever the values of p and q ; hence there can not